Title: Modification to a Commercial Source Projector Assembly with an Unintended Reduction in the Level of Safety

Date: March 3, 2002

Identifier:

Lessons Learned Statement:

Reliance on a lower level of control (administrative – keeping source upright) should not be used when a higher level of control (engineering – locking source down) is readily available.

Discussion:

Fermilab uses two commercial projectors containing Cs-137 sources to provide the high intensity gamma radiation fields necessary to test and calibrate its radiation safety instrumentation in compliance with 10 CFR 835.401. These projectors each consist of a shielding "pig" equipped with a collimated beam port. One projector contains a single source with a lead and tungsten pig while the other one is a dual projector, with 2 sources in a lead pig. The set of 3 sources provides about 3 decades of activity levels. The pig for the largest source is a cylinder, 27.3 cm in diameter and 43.2 cm in length. Within each pig the source or sources are mounted on a rod that must be manually lifted vertically via a right angle lift arm to move the source upward into the "open" position, aligned with the collimated beam port. Above each pig, the vendor has provided an electromechanical control mechanism for holding the source rods in the "open" position.

The original sources in the single projectors had been procured in 1973, and thus by 2001 had significantly degraded by decay. During CY 2001 arrangements were made to return the device to the original vendor for replacement of the original source with ones having higher activity activity levels. To prepare for this shipment, the Fermilab equipment was disconnected from the vendor controls atop the projector. Out of concern for possible damage in transit, the lift arms for manually raising the sources into the open positions were also removed. Metal locking bars were placed transversely through a set of 2 vendor-provided holes and padlocked in place in the belief that they prevented inadvertent motion of the sources into the open position. The shipments were subsequently made to and from the vendor in compliance with U. S. Department of Transportation Regulations in an overpacked Type B container for the single source projector and a Type A container for the dual projector. The projectors were handled and shipped with the source rods oriented vertically, in an upright position.

Following the return of the projector with the new source, on January 23, 2002, it was discovered that the locking bar was not effective in preventing the lifting of the source of the single projector into the open position should the source rotate about its axis. This was due to the fact that the locking bar neither intersected the axis of the source rod nor blocked its movement under all angles of rotation. Had the lift arm been left in place, or

had a surrogate such as a piece of threaded rod been installed, this rotational motion would have been rendered impossible and the source would have been held in place.

Projector Arm with Shaft in Place

Projector Arm with Shaft Removed

Detail showing how the mounting blocked with the lift arm removed from the threaded hole is no longer constrained by the locking
bar in the right side of the picture.

Analysis:

In the event of a major transportation accident involving the release of the load from its confinement on the transport vehicle, it is conceivable that the single source projector could have fallen into a horizontal orientation that might have permitted the source to slide into the open position. If this had happened in the shipment from Fermilab to the vendor, the "old" source being in the open position represented a potential accidental exposure rate of 18.6 R/hr at one meter. If this had happened in the return shipment, the "new" source being in the open position represented a potential accidental exposure rate of 64.4 R/hr at one meter. It is important to add that upon receipt, radiation surveys and detailed inspections of the shipping containers indicated that the transportation was accomplished in an orderly manner and free of incidents. For both the outgoing and incoming shipments, the container and the source projector was found to be correctly oriented with the source in its shielded position. It was thus determined that no measurable radiation exposures were attributable to these shipments.

This event resulted from the inadvertent reliance on a lower level of administrative control (i.e., keeping the single source projector upright) when a higher level (locking the source down) was intended. The concern is that the source was not handled and stored in a manner commensurate with the hazards associated with a source of this level of activity. It is also noted that the vendor likewise overlooked this potential problem in the course of preparing the return shipment. Clearly, more attention to the effectiveness of the vendor-supplied controls and the equipment developed in house would have prevented the event. Given the long periods of time between servicing of these projectors,

there is a need to carefully document the physical controls needed as future operations of this kind will likely be performed by personnel not involved in the present incident.

Recommened Actions:

The vendor was notified of this possible failure mode.

Priority Descriptor:

Yellow

Work/Function Categories:

Radiation Protection

Hazard:

Personal Injury – Radiation/Contamination

ISM Category:

Analysze Hazards

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